CHAPTER 5 ELECTRIC CURRENTS

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1. C
2. A
3. B
4. B
5. A
6. B
7. a) electrons b) Na^+ and Cl^-
8. a) collisons with the crystal lattice atoms b) collisions with lattice atoms transfers energy.
9. 0.2 Ω
10. 5.0×10^{-3} A
11. 1.35 V
12. 280 m
13. 50 m
14. Electrons drift through the lattice, as temperature increases the lattice atoms vibrate more and this increases the probability of collision and hence resistance to electrons has increased.
15. 7200 C
16. Ohmic: constant resistance, I-V garph is linear through origin;

    Non–ohmic: non-linear I-V graph
17.

Appliance	Power (Watt)	p.d (Volt)	Current (Ampere)	Fuse rating needed (3,5,10,13 A)
Digital clock	4	240	1.7 102	3
Television	200	240	0.83	3
Hair dryer	550	110	5	10
Iron	920	230	4	5 or 10
Kettle	2400	240	10	13

18. 23 cents
19. 9.3 °C
20. $2.86
21. 1.5×10^{-6} J
22. 2.5×10^{3} eV.

CHAPTER 5 ELECTRIC CURRENTS

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1. A
2. D
3. C
4. D
5. A
6. B
7. C
8. A. (1 / R = 1/3 +1/3 + 1/3 = 3/3 R = 1Ω)
9. B. (W = qV V = 18J / 2 C = 9.0 V)
10. C. (One ampere is defined as the current flowing in 2 infinitely-long wires of negligible cross-sectional area separated by a distance of one metre in a vacuum that results in a force of exactly 2×10^{-7} N per metre of length in each wire).
11. C. (P = VI. If the voltage is constant, power is directly proportional to the current).
12. A. (Closing the switch will create a short-circuit, and the electrons will by-pass lamp 2, other lamps will then be brighter).
13. C. ($1/R = 1/R_1 + 1/R_2$ $1/R = R_2 + R_1 / R_1R_2$ $R = R_1R_2 / R_1 + R_2$)
14. B. ($V_1 = I_1R_1 = (100)(2.2 \times 10^{-3}) = 0.22$ V

    $V_2 = I_2R_2 = (150)(1.5 \times 10^{-3}) = 0.225$ V

    $V_1 = -I_1 r + \varepsilon$ $0.22 = -(2.2 \times 10^{-3})\, r + \varepsilon$

    $V_2 = -I_2 r + \varepsilon$ $0.225 = -(1.5 \times 10^{-3})\, r + \varepsilon$

    Subtracting equations $-0.005 = -(0.7 \times 10^{-3})r$

    $r = 7.143\ \Omega$)
15. C. (V = IR = 12 / 6 = 2A)
16. C. (1 / R = ¼ + ¼ = 2/4 R = 2 Ω $R_{eff} = 2 + 3 = 5\Omega$

    I = 15 / 5 = 3A V in 3Ω resistor = 3Ω x 3A = 9V

    Therefore, voltage across XY = 15 – 9 = 6V)
17. a) 22 Ω b) 2 Ω
18. 2.9×10^{3} J
19. a) 24.4 Ω b) 0.5 A c) 10 V d) 1.2 V e) 0.3 A
20. 4.7 Ω
21. When a dry cell goes "flat" its internal resistance has become large. Therefore it can't really charge it. NiCad batteries have a very low internal resistance. Also dry cell chemistry is not reversible.
22. a) 1.54 V b) 0.74 Ω.

23. $I = \Delta q / \Delta t = (2.40 \times 10^3 \text{ C}) / (3.0 \text{ min}) (60 \text{ s.min}^{-1}) = 13.3$ A.

The current flowing is 13A.

24. V= IR R = V / I R = (240 V) / (6.0 A) = 40 Ω.

The resistance of the iron is 4.0×10^1 Ω.

25. (a) P = V.I I = P / V I = 2.5×10^3 J / 240 V = 10.4 A

The current drawn is 1.0×10^1 A.

(b) W = V.I.t = (240 V) . (10.4 A) . ($7.2 . 10^3$ s) = 1.8×10^7 J

The energy consumed is 1.8×10^7 J.

26. Energy consumed = power . time = 2.5 kW x 8 h = 20 kW.h

Cost = (20 kW.h) x \$0.14 =\$ 2.4. The cost to run the heater is two dollars forty cents.

27. (i) Voltage in bottom arm is 100 V

V=IR 100 = I (1.0 Ω + 3.0 Ω) Current in bottom arm I = 25 A.The current entering the top arm = 35 – 25 = 10 A

Voltage in 4.0 Ω resistor = IR = 10 A x 4.0 Ω = 40 V

Voltage in R and 24.0 Ω resistor = 100 – 40 V= 60 V

The current in the 24.0 Ω resistor = V / R = 60 / 24 = 2.5 A

Current in R = 10 - 2.5 A = 7.5 A

R = V / I = 60 V / 7.5 A = 8.0 Ω

(ii) 40 V – 25 V = 15 V

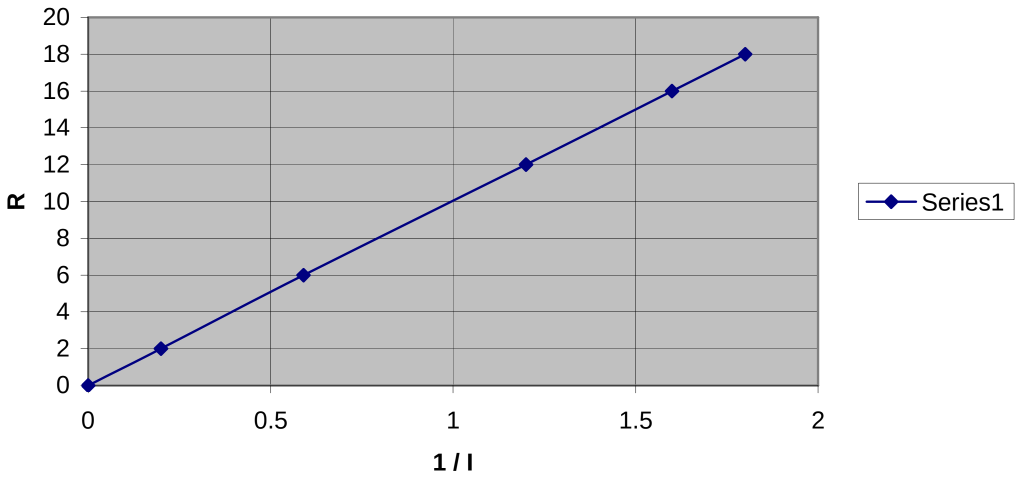
28 (i) 12 V means that it requires 12 J of energy to move 1 coulomb of charge between two points.

(ii) ε = IR +Ir 14 =12 + 5r r = 0.4 Ω

29. (a)

$R \pm 0.5\Omega$	$I \pm 0.1$ A	$1 / I$ A^{-1}
2.0	5.0	0.20
6.0	1.7	0.59
12	0.83	1.2
16	0.63	1.6
18	0.56	1.8

(b)



(c) the resistance is directly proportional to 1/*I* OR the resistance is inversely proportional to the current OR other correct statement

(d) the e.m.f. is the slope of the graph

emf = 10 / 1.0 = 10V

30. From the law of conservation of charge: $I = I_1 + I_2$

From the law of conservation of energy: $V = V_1 = V_2$

From Ohm's law $R = V / I$ $\therefore$ $1/R = I / V$

$1/R = I_1 / V + I_2 / V$ AND $V = V_1 = V_2$

$\therefore$ $1/R = I_1 / V_1 + I_2 / V_2 = 1 /R_1 + 1 / R_2$

31. a) $R_{ABC} = 3\Omega$ $R_{ADC} = 1.5\Omega$

$1/R = 1/3 + 2/3 = 1$ $R_{AC} = 1\ \Omega$

Effective resistance = 1 + 1 = 2 Ω

(b) Total current $I = V / R_{eff} = 1.5 / 2 = 0.75$ A

Voltage in 1Ω series resistor = (1)(0.75) = 0.75 V

Voltage in each network = 1.5 – 0.75 = 0.75 V

$I_{ABC} = (0.75) / 3 = 0.25$ A $I_{ADC} = 0.75 / 1.5 = 0.5$ A

(c) $V_{AB} = (1)(0.25) = 0.25$ V $V_{AD} = (0.5)(0.5) = 0.25$ V

(d) 0 V

32. Voltage in the 1 kΩ resistor: $V = IR = 1000 \times 4.5 \times 10^{-3} = 4.5$ V

Therefore, voltage in the LDR = 4.5 V.

Resistance in the LDR = $4.5 / 4.5 \times 10^{-3} = 1000 = 1$ kΩ